



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OFFICE OF
AIR AND RADIATION

Mr. Tomas Haapala
Energy and Drives, Engineer
Konecranes PLC
Koneenkatu 8
Hyvinkaa Finland, 05830

Dear Mr. Haapala:

The U.S. Environmental Protection Agency (EPA) has reviewed your request for verification of the Konecranes PLC’s (Konecranes) EcoLifting Hybrid System (or EcoLifting). The EcoLifting Hybrid System replaces the conventional diesel generator set(s) on a rubber-tired gantry crane (RTG). The EcoLifting Hybrid System includes a new diesel engine generator set, battery package with cooling system, active rectifier, control system, auxiliary converter and energy recovery capabilities. Based on our evaluation of your application, test data, and analysis provided by Konecranes, EPA hereby verifies that this technology reduces emissions of certain pollutants and improves fuel consumption by the percentages described below provided all of the operating criteria are met.

This approval is to replace an original Tier 0, Tier 1, Tier 2 or Tier 3 diesel engine-equipped RTG generator with an EcoLifting Hybrid System equipped with an engine meeting final Tier 4 (Tier 4F) emissions standard. The emission reductions below are based on an RTG originally equipped with a Tier 3 engine generator which was replaced with an EcoLifting Hybrid System utilizing a Tier 4F engine. This testing also demonstrated a 30% or greater fuel economy improvement depending on the operating conditions.

Technology	Particulate Matter (PM) %	Carbon Monoxide (CO) %	Hydrocarbons (HC) %	Oxide of Nitrogen (NOx) %	Carbon Dioxide (CO2) %
Tier 4F EcoLifting Hybrid System	90	90	90	90	30

Note that these values are based on Tier 4F EcoLifting Hybrid System equipped with an engine that does not use emission credits. If a Tier 4F engine certified using credits is incorporated in this system, the reductions may be lower. These reduction levels are based on an RTG equipped with a conventional Tier 3 engine generator being retrofit with a Tier 4F EcoLifting. Emission reductions may be greater when the original RTG generator is equipped with a Tier 0, Tier 1 or Tier 2 engine.

The following operating criteria must be met to achieve the aforementioned emissions reduction.

- 1) The original RTG generator(s) must be equipped with a Tier 0, Tier 1, Tier 2 or Tier 3 engine(s).
- 2) The original RTG must be equipped with a DC bus or the EcoLifting Hybrid System package needs to be equipped with properly sized power frequency converters with common DC bus capability.
- 3) Prior to installation, Konecranes must appropriately size the EcoLifting Hybrid System for the original RTG. In sizing the EcoLifting Hybrid System, a smaller horsepower new Tier 4F diesel

engine-equipped generator and battery-equipped energy system must be optimized to satisfy application-specific requirements.

- 4) The EcoLifting Hybrid System includes the components necessary to replace a conventional RTG diesel engine generator and other original power system components as necessary. The EcoLifting components include a new genset equipped with a new Tier 4F diesel engine, exhaust system, battery energy storage system, battery monitoring system, battery cooling and heating system, regenerative brake/energy recovery system, and typically other components as necessary including DC/DC converter, active rectifier, auxiliary converter system, and electrical & mechanical components needed to integrate the system to the crane.
- 5) EcoLifting and the RTG owner must evaluate battery technology options for the specific RTG. Different battery technologies may be preferred due to individual preference and performance requirements, so it is the responsibility of Konecranes and the RTG owner to select a battery technology and size based on these needs.
- 6) The EcoLifting Hybrid System must include a battery monitoring system to alarm operators for necessary actions to ensure the proper operation of the batteries.
- 7) The owner's manual must include maintenance procedures, safety precautions information and battery disposition information.
- 8) The engine must be operated on ultra-low sulfur diesel fuel (ULSD) of 15 ppm or less.
- 9) The engine used in the EcoLifting Hybrid System must be certified for use in generator sets and meet current model year standards.

If Konecranes's EcoLifting Hybrid System is modified from the application description provided to EPA, you must notify EPA immediately. This verification does not automatically confer to modified devices or devices that are similar to this original verification.

Information on Konecranes's EcoLifting Hybrid System, percent reduction, and applicable engines will be posted on the EPA's Verified Technology List website at: <https://www.epa.gov/verified-diesel-tech/verified-technologies-list-clean-diesel>. As you know, Konecranes will be responsible for completing the required in-use testing program and for submitting all in-use testing data to EPA as outlined in EPA's in-use test methods.

Thank you for participating in EPA's Technology Assessment Center Verification Program. If you have any questions or comments, please contact Kuang Wei, of my staff, at 202-343-9329.

Sincerely,

Karl Simon, Director
Transportation and Climate Division
Office of Transportation and Air Quality